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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
MURALIDAR, RICHARD V	

ART UNIT	PAPER NUMBER
2838	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/823,305	DEWEY, SCOTT
	Examiner	Art Unit
	Richard V. Muralidar	2838

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 03/14/2007.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-20 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 13 April 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

In view of the appeal brief filed on 12/27/2006, PROSECUTION IS HEREBY REOPENED. New grounds of rejection are set forth below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-4, 6-10, 12-17, 19 and 20 are rejected under 35 U.S.C. 103(a) as being obvious over Barbetta [U.S. 6762587] in view of Yoshino et al. [U.S. 4937521].

With respect to Claim 1, Barbetta teaches a monitoring system [Fig. 1, 2, 3 fuel cell monitoring system] for monitoring the voltage potential of fuel cells in a fuel cell stack [Figs. 1, 2, 3 fuel cell stack 10, 20; col. 1 lines 12-20; col. 2 lines 36-43; col. 4 lines 6-12]; a conductor [Fig. 1, conductor 12; col. 4 lines 25-29; col. 5 lines 36-47; Fig. 2; conductive trace 21] positioned proximate to a voltage measuring means [Fig. 1, meter 13; col. 4 lines 30-35; col. 5 lines 52-63 the meter comprises attenuator 4 and amplifier 5]; a plurality of switches [Fig. 8, multiplexer 2; col. 6 lines 37-41] electrically coupled to the fuel cells and to the conductor [Fig. 7; col. 5 lines 52-63], said switches being selectively switched on and off to separately and selectively couple each fuel cell in the fuel cell stack to the conductor and generate a current flow therethrough [col. 7 lines 22-32]. Barbetta teaches a differencing amplifier 5 connected to an attenuator 4

(i.e. a voltage divider, col. 6 lines 14-17) as shown in Fig. 7 and disclosed in col. 5 lines 52-64, which is connected directly to the multiplexer 2 for reading the voltages of individual cells; said differencing amplifier providing an output signal indicative of the voltage potential of the selected fuel cell [col. 5 lines 52-63]. Barbetta does not teach an intermediate stage between the fuel stack multiplexer (plurality of switches) and the differencing amplifier, comprising a Wheatstone bridge with a GMR resistor and two output ports.

Yoshino teaches a current sensor [col. 1 lines 8-12] comprising a Wheatstone bridge [Fig. 11; col. 8 lines 32-38], said Wheatstone bridge including at least one giant magnetoresistive (GMR) resistor [Fig. 11, magnetoresistor 1; col. 5 lines 7-13] and two output ports [Fig. 11, nodes 8a and B prime]; that includes sensing a magnetic field generated by the current flow through the conductor reduces the resistance of the GMR resistor and unbalances the Wheatstone bridge [col. 5 lines 37-41 and lines 52-55; col. 7 lines 4-5]; and a differencing amplifier [Fig. 11, comparator 40; col. 8 lines 38-41] electrically coupled to the output ports of the Wheatstone bridge.

Barbetta and Yoshino are analogous current measuring devices. At the time of the invention it would have been obvious to add a Wheatstone bridge with GMR type resistors to Barbetta for the benefit of accurately reading current/voltage of each cell whilst ensuring isolation existed between the cell's high voltage and the measurement electronics, particularly since Barbetta's sensor is connected to a conductive trace [Barbetta- col. 5 lines 36-43], and Yoshino's sensor is designed to sense current flowing through a conductive trace, without touching it [Yoshino- Fig. 11; col. 3 lines 49-

63]. Additionally, Wheatstone bridges with GMR type resistors used to measure current from magnetic fields are widely known in the art, and would function *exactly the same way* whether connected to a single battery, multiple batteries, or multiple fuel-cells. Further benefit gained through the use of Yoshino's GMR sensor is to overcome the difficulties associated with using coils as current measuring devices [col. 1 lines 14-40]; and additionally to follow the widespread trend of semiconductor integration of sensors, with inherent advantages, in today's electronics [col. 1 lines 54-56].

With respect to Claim 2, Barbetta teaches the switches are FET switches [col. 7 lines 37-41].

With respect to Claim 3, Yoshino teaches the at least one GMR resistor is two GMR resistors [Fig. 13, GMR resistors 1].

With respect to Claim 4, Yoshino teaches the conductor is an electrical trace positioned beneath the Wheatstone bridge [col. 1 lines 8-12; col. 3 lines 49-64; col. 5 lines 7-13].

With respect to Claim 6, Barbetta teaches least one voltage divider [Fig. 7, attenuator 4 is a voltage divider- col. 6 lines 14-17] electrically coupled between the fuel cells and the conductor.

With respect to Claim 7, Barbetta teaches a controller [Fig. 7, microprocessor 7; col. 5 lines 52-66] for controlling the switches to separately measure the voltage potential of each fuel cell and for receiving the output signal from the amplifier [Fig. 7, amplifier 5].

With respect to Claim 8, Barbetta teaches a plurality of opto-isolators for isolating the high voltage of the fuel cell stack and the switches from the low voltage of the controller [col. 7 lines 22-32 and lines 37-41, isolation may be provided, such as with mechanical relays; col. 6 lines 34-36, opto-isolators may also be used to provide isolation].

With respect to Claim 9, Barbetta teaches the system monitors the fuel cell stack on a vehicle [col. 3 lines 12-17].

With respect to Claim 10, Barbetta teaches a monitoring system [Fig. 1, 2, 3 fuel cell monitoring system] for monitoring the voltage potential of fuel cells in a fuel cell stack [Figs. 1, 2, 3 fuel cell stack 10, 20; col. 1 lines 12-20; col. 2 lines 36-43; col. 4 lines 6-12]; *an electrical trace* [Fig. 1, conductor 12; col. 4 lines 25-29; col. 5 lines 36-47; Fig. 2; conductive trace 21] positioned proximate to a voltage measuring means [Fig. 1, meter 13; col. 4 lines 30-35; col. 5 lines 52-63 the meter comprises attenuator 4 and amplifier 5]; a plurality of *FET switches* [Fig. 8, multiplexer 2; co. 6 lines 37-41, MOSFET switches] electrically coupled to the fuel cells and to the conductor [Fig. 7; col. 5 lines 52-63], said switches being selectively switched on and off to separately and selectively couple each fuel cell in the fuel cell stack to the conductor and generate a current flow therethrough [col. 7 lines 22-32]; and *a controller* [Fig. 7, microprocessor 7; col. 5 lines 52-63] for controlling the switching of the FET switches to separately measure the voltage potential of each fuel cell and for receiving the output signal from the amplifier. Barbetta teaches a differencing amplifier 5 connected to an attenuator 4 (i.e. a voltage divider, col. 6 lines 14-17) as shown in Fig. 7 and disclosed in col. 5 lines

52-64, which is connected directly to the multiplexer 2 for reading the voltages of individual cells; said differencing amplifier providing an output signal indicative of the voltage potential of the selected fuel cell [col. 5 lines 52-63]. Barbetta does not teach an intermediate stage between the fuel stack multiplexer (plurality of switches) comprising a Wheatstone bridge with a GMR resistor and two output ports.

Yoshino teaches a current sensor [col. 1 lines 8-12] comprising a Wheatstone bridge [Fig. 11; col. 8 lines 32-38], said Wheatstone bridge including at least one giant magnetoresistive (GMR) resistor [Fig. 11, magnetoresistor 1; col. 5 lines 7-13] and two output ports [Fig. 11, nodes 8a and B prime]; that includes sensing a magnetic field generated by the current flow through the conductor reduces the resistance of the GMR resistor and unbalances the Wheatstone bridge [col. 5 lines 37-41 and lines 52-55; col. 7 lines 4-5]; and a differencing amplifier [Fig. 11, comparator 40; col. 8 lines 38-41] electrically coupled to the output ports of the Wheatstone bridge.

Barbetta and Yoshino are analogous current measuring devices. At the time of the invention it would have been obvious to add a Wheatstone bridge with GMR type resistors to Barbetta for the benefit of accurately reading current/voltage of each cell whilst ensuring isolation existed between the cell's high voltage and the measurement electronics, particularly since Barbetta's sensor is connected to a conductive trace [Barbetta- col. 5 lines 36-43], and Yoshino's sensor is designed to sense current flowing through a conductive trace, without touching it [Yoshino- Fig. 11; col. 3 lines 49-63]. Additionally, Wheatstone bridges with GMR type resistors used to measure current

from magnetic fields are widely known in the art, and would function *exactly the same way* whether connected to a single battery, multiple batteries, or multiple fuel-cells. Further benefit gained through the use of Yoshino's GMR sensor is to overcome the difficulties associated with using coils as current measuring devices [col. 1 lines 14-40]; and additionally to follow the widespread trend of semiconductor integration of sensors, with inherent advantages, in today's electronics [col. 1 lines 54-56].

With respect to Claim 12, Barbetta teaches at least one voltage divider [Fig. 7, attenuator 4 is a voltage divider- col. 6 lines 14-17] electrically coupled between the fuel cells and the trace.

With respect to Claim 13, Barbetta teaches a plurality of opto-isolators for isolating the high voltage of the fuel cell stack and the FET switches from the low voltage of the controller [col. 7 lines 22-32 and lines 37-41, isolation may be provided, such as with mechanical relays; col. 6 lines 34-36, opto-isolators may also be used to provide isolation]

With respect to Claim 14, Barbetta teaches a method [Abstract, lines 1-3] for monitoring [Fig. 1, 2, 3 fuel cell monitoring system] the voltage potential of fuel cells in a fuel cell stack [Figs. 1, 2, 3 fuel cell stack 10, 20; col. 1 lines 12-20; col. 2 lines 36-43; col. 4 lines 6-12]; providing a conductor [Fig. 1, conductor 12; col. 4 lines 25-29; col. 5 lines 36-47; Fig. 2; conductive trace 21] positioned proximate to a voltage measuring means [Fig. 1, meter 13; col. 4 lines 30-35; col. 5 lines 52-63 the meter comprises attenuator 4 and amplifier 5]; selectively and separately electrically coupling the fuel cells to the conductor to generate a current flow through the conductor [Fig. 7; col. 5

lines 52-63; col. 7 lines 22-32]; and a differencing amplifier [Fig. 7, amplifier 5] providing an output signal indicative of the voltage potential of the selected fuel cell [col. 5 lines 52-63]. Barbetta does not teach an intermediate stage between the fuel stack multiplexer (plurality of switches) and the differencing amplifier, comprising a Wheatstone bridge with a GMR resistor and two output ports.

Yoshino teaches a current sensor [col. 1 lines 8-12] comprising a Wheatstone bridge [Fig. 11; col. 8 lines 32-38], said Wheatstone bridge including at least one giant magnetoresistive (GMR) resistor [Fig. 11, magnetoresistor 1; col. 5 lines 7-13] and two output ports [Fig. 11, nodes 8a and B prime]; that includes sensing a magnetic field generated by the current flow through the conductor reduces the resistance of the GMR resistor and unbalances the Wheatstone bridge [col. 5 lines 37-41 and lines 52-55; col. 7 lines 4-5]; and a differencing amplifier [Fig. 11, comparator 40; col. 8 lines 38-41] electrically coupled to the output ports of the Wheatstone bridge.

Barbetta and Yoshino are analogous current measuring devices. At the time of the invention it would have been obvious to add a Wheatstone bridge with GMR type resistors to Barbetta for the benefit of accurately reading current/voltage of each cell whilst ensuring isolation existed between the cell's high voltage and the measurement electronics, particularly since Barbetta's sensor is connected to a conductive trace [Barbetta- col. 5 lines 36-43], and Yoshino's sensor is designed to sense current flowing through a conductive trace, without touching it [Yoshino- Fig. 11; col. 3 lines 49-63]. Additionally, Wheatstone bridges with GMR type resistors used to measure current

from magnetic fields are widely known in the art, and would function *exactly the same way* whether connected to a single battery, multiple batteries, or multiple fuel-cells. Further benefit gained through the use of Yoshino's GMR sensor is to overcome the difficulties associated with using coils as current measuring devices [col. 1 lines 14-40]; and additionally to follow the widespread trend of semiconductor integration of sensors, with inherent advantages, in today's electronics [col. 1 lines 54-56].

With respect to Claim 15, Barbetta teaches the method according to claim 14 wherein selectively and separately electrically coupling the fuel cells to the conductor includes using FET switches [Fig. 8, multiplexer 2; co. 6 lines 37-41, MOSFET switches] to selectively and separately electrically couple the fuel cells to the conductor [col. 7 lines 22-32].

With respect to Claim 16, Yoshino teaches providing a conductor positioned proximate to the Wheatstone bridge includes providing an electrical trace positioned beneath the Wheatstone bridge [col. 1 lines 8-12; col. 3 lines 49-64; col. 5 lines 7-13].

With respect to Claim 17, Yoshino teaches providing a Wheatstone bridge includes providing a Wheatstone bridge including two GMR resistors [Fig. 13, GMR resistors 1].

With respect to Claim 19, Barbetta teaches providing at least one voltage divider [Fig. 7, attenuator 4 is a voltage divider- col. 6 lines 14-17] electrically coupled between the fuel cells and the conductor.

With respect to Claim 20, Barbetta teaches the fuel cell stack is on a vehicle [col. 3 lines 12-17].

Claims 5, 11, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barbetta [U.S. 6762587] and Yoshino et al. [U.S. 4937521] as applied to the above claims, in view of Chen [U.S. 5371455], and further in view of Thiele [U.S. 3500372].

With respect to Claims 5, 11, and 18, the combination of Barbetta and Yoshino teaches a fuel cell with a multiplexer which monitors each of the fuel cells of a fuel stack for voltage; through the use of a GMR sensor [see Claim 1 above]. The combination of Barbetta and Yoshino does not teach a polarity reverser between the fuel cell and the voltage monitor.

Chen teaches an automatic polarity reverser [Fig. 1, col. 1 lines 50-68 and col. 2 lines 1-2], said polarity reverser reversing the polarity of the current from the cells before the current is applied to the conductor so that the current through the conductor is always in the same direction.

Thiele teaches that electrochemical/fuel cells are known to experience damaging polarity reversals during internal functional faults [Col. 1 lines 12-39].

Barbetta, Yoshino, Chen, and Thiele are analogous voltage/current monitoring devices.

It would have been obvious to one of ordinary skill in the art at the time of the invention to add an automatic polarity reversal mechanism as taught by Chen, to the combination of Barbetta and Yoshino for the benefit of preventing potentially damaging fuel cell polarity reversals [as motivated by Thiele, col. 1 lines 30-39; and Chen, col. 1 lines 27-33] from damaging the system, such as the polarity dependent differencing

amplifier of the GMR sensor [Yoshino, Fig. 12, 41- positive and negative inputs must be supplied as shown or damage can potentially occur. The current flow arrow I shown in figs. 11-13 indicate that current flow must occur in one direction only].

Response to Arguments

Applicant's arguments with respect to claim 5, 8, and 11 have been considered but are moot in view of the new ground(s) of rejection. Applicant's arguments with respect to claims 1, 10, and 14 [i.e. the combination of Barbetta and Yoshino] are unpersuasive- see action above and past response to Arguments.

Conclusion

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Richard V. Muralidar whose telephone number is 571-

272-8933. The examiner can normally be reached on 9:00-5:30. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Karl D. Easthom can be reached on 571-272-1989. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below.

/Richard V. Muralidar/
Examiner, AU 2838
8/3/2007

KARL EASTHOM
SUPERVISORY PATENT EXAMINER